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To: Mr. J. L. Charles

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From: R. D. Hellams

Subject: Charge Number 6910 (Condensate Preparation, Processing, and Pyrolysis Studies) Plans and Objectives for 1982

I. INTRODUCTION

The objectives of this newly formed project (October 1, 1981) were formerly a part of Charge Number 6908.[1] The principal areas of activity for this project are summarized in the following goals:

a) Collect and process cigarette smoke condensate for *in vivo* testing.

b) Collect and process mainstream cigarette smoke by appropriate methods for *in vitro* and chemical testing.

c) Study methods for smoking and collection of sidestream cigarette smoke for *in vitro* and chemical testing.

d) Develop and study pyrolysis conditions on the pyrolysis of varied cigarette fillers to aid in understanding *in vitro* assay activity.

e) Prepare, smoke, and/or pyrolyze varied LTF formulations for use in a collaborative study of precursor-smoke product relationship on *in vitro* or *in vivo* assay activity.

II. *IN VIVO* STUDY

Our major responsibility for the coming year is to supply smoke condensate for an *in vivo* test beginning the first quarter of 1982.

This test will consist of four cigarette types to be smoked. The condensate will be trapped in Elmenhorst cold traps[2] and processed to prepare acetone solutions of the condensate for outside testing.

The following plans and objectives for 1982 for this project are contingent due to the time and personnel available to first accomplish the above major responsibility.

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III. MAINSTREAM CIGARETTE SMOKE (with 6900, 6902, 6904, 6906, and 6908)

Trapping Methods for *in vitro* and Chemical Testing

Mainstream cigarette smoke will continue to be collected for *in vitro* and chemical testing. Various trapping methods either alone or in combination have been used for the collection of cigarette smoke condensate and/or smoke volatiles.

1. The Impaction Trap

The impaction trap[3] has been the major trapping technique used to collect smoke condensate for *in vitro* and chemical testing in our laboratory. This trapping technique is ideal for numerous small batch smokings for *in vitro* testing. The smoke condensate sample is taken up directly in DMSO for testing without further handling.

2. The Solvent Filled Impaction Trap

An impaction trap containing a solvent such as DMSO will be used to trap mainstream smoke volatiles for special *in vitro* tests such as the L5178Y thymidine kinase (TK) mutation assay. Other such uses of this technique will be the trapping of nicotine in an acid solution for the volatile phase exiting the dry impaction trap during the collection of mainstream and sidestream smoke.

3. The Elmenhorst Cold Trap

The Elmenhorst cold trap has been the principal collection method for collecting large quantities of cigarette smoke condensate to be used for *in vivo* tests. This collection system will continue to be used for special smoke condensate tests such as acids, bases, and neutral fractionation studies for chemical and/or *in vitro* testing. It will be used to collect smoke condensate from high nitrate cigarettes in a comparative study of the chemistry of this condensate *versus* that of condensate collected in an impaction trap.

4. The Cambridge Filter Pad

The Cambridge filter pad will continue to be used in the collection of mainstream smoke in the sidestream smoke studies as well as for small tests to check the delivery of a new cigarette.

5. Volatiles and/or Gas Phase Collection

Collection of volatile phase and gas phase cigarette smoke continues to be of interest in the areas of chemical analysis and *in vitro* assay activity of such compounds as carbonyls. Profiling studies of volatile phase and/or gas phase of cigarette smoke by appropriate methods (gc, lc, gc/ms) will be pursued as time permits.

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IV. SIDESTREAM CIGARETTE SMOKE (with 6902, 6904, 6906, and 6908)

A. Smoke Chamber Design Study

The increasing importance of sidestream smoke studies point to the need of a faster method for smoking and collecting sidestream cigarette smoke. The present method of smoking one cigarette at a time in a sidestream smoke chamber is time-consuming. An ideal initial improvement for collecting sidestream smoke would be the ability to smoke at least four cigarettes at one time in a sidestream smoke chamber for small scale *in vitro* and chemical testing.

B. Large Scale Collection of Sidestream Cigarette Smoke

An even greater need is the large scale collection of sidestream smoke from a 30-port Borgwaldt smoking machine for use in sidestream smoke condensate fractionation studies. Other areas of interest would be the collection of the volatile phase and the gas phase of sidestream cigarette smoke. The initial attempt at a large scale collection method for sidestream smoke will focus on the particulate phase.

C. Collection for *in vitro* Testing and Chemical Testing

Appropriate collection methods will be utilized for sidestream smoke collection whether for *in vitro* testing or for chemical testing.

Sidestream impaction trapped condensate samples for a limited number cigarette types will be tested in the *Salmonella*/microsome assay.

Additional chemical fractionation studies of impaction trapped sidestream smoke for varied cigarette types are planned. Of particular interest is base fraction *Salmonella*/microsome activity and MS/SS ratios for components such as 2-amino-α-carboline.

Vapor phase sidestream smoke collected in a cold trap or in an impaction trap containing a solvent will be collected for chemical profiling studies (gc, gc/ms) as time permits.

Cambridge pad collected sidestream TPM will be collected and compared in the *Salmonella*/microsome assay to Cambridge pad collected mainstream smoke for the same cigarette(s). Initial prior tests of these pads placed directly in DMSO in a screw capped vial to reduce water absorption from the atmosphere have been successful as a test procedure. This procedure will continue to be evaluated as an efficient procedure to eliminate DMSO extraction of the pads in a fritted funnel. This would also reduce equipment cleanup time.

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D. Nitrosamines in Sidestream Smoke

Initial experiments were successful for the collection of sidestream volatile and nonvolatile nitrosamines. Two gas washing bottles in series containing pH 4.5 citrate buffer with ascorbic acid--as used by Project 6908 for volatile and nonvolatile nitrosamines in mainstream smoke--are connected to the exit of the presently used sidestream smoke chamber.[4] Development work with 6908 is planned in the area of introducing nitrogen into the sidestream smoke stream at varied flow rates to determine the effect of reducing artifactual formation of volatile nitrosamines. Also, the technique will be used to determine if there is an effect on the nonvolatile tobacco-specific nitrosamines in the more inert atmosphere.

E. Collaborative Effort with Charge Number 4009 on High Priority Samples

During this year several cigarettes with special wrappers to reduce sidestream smoke were tested by the sidestream smoking-testing procedure we are presently using. Due to the high demand of time on our projected goals for 1982, this type sample for sidestream smoke "analysis" will need to be of a high priority nature as determined by the Biochemical Research Division Manager and/or Technical Coordinator.

IV. PYROLYSIS STUDIES (with 6906 and 6908)

The small Mellen furnace has been used successfully during the current year for many pyrolysis studies. The simpler designed quartz pyrolysis tube has allowed the pyrolysis of filler at higher temperatures (up to 900°C *versus* previous maximum of 650°C). Also, the filler sample size has been reduced from 5 grams as used with the large Mellen furnace to 2 grams with the smaller oven.

Additional studies are planned which include the pyrolysis of varied fillers and blends, the effect on activity of varied oxygen atmospheres *versus* the nitrogen and air atmospheres presently being studied.

The preparation of pyrolyzate base fractions from selected fillers are planned for *in vitro Salmonella*/microsome assay testing and chemical profiling. Pre-treatment of filler as with potassium salts or nicotine prior to pyrolysis and alternate pyrolysis procedures are planned.

Pyrolyzate chemistry such as the gc, gc/ms study of the volatiles not trapped in the DMSO used to collect the pyrolyzate for *in vitro* testing will be undertaken as time permits.

V. LTF PREPARATION STUDIES (with 6904, 6906, and 6908)

The preparation of LTF-5E control sheet material or control LTF with various additives will be used to support varied research studies. The sheet material will be prepared on an "as needed" basis. The sheet material will be shredded for filler and made into cigarettes and smoked for *in vitro* tests and chemical tests, or as filler for pyrolysis studies.

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VI. SUMMARY OF PLANS FOR 1982

Activity	Timetable
A. *In Vivo* Study	Initiate first quarter
1. Four cigarette types to be smoked	
2. Elmenhorst cold trapped	
B. Mainstream Cigarette Smoke	
1. Collection methods for *in vitro* and chemical studies	
a. Impaction trap	Ongoing
(1) Normal smoking procedure for trapping CSC for	
(a) *in vitro* tests	
(b) chemical analysis	
b. Elmenhorst cold trap	
(1) Special tests	
(a) nitrate addition to filler	Second - third quarter
(2) Large quantities of CSC	
(a) chemical fractionation studies	On request
c. Solvent filled impaction trap	
(1) Special tests	
(a) L5178Y	Ongoing
(b) nicotine	Second - third quarter
d. Cambridge pad	
(1) *in vitro* assay	Second - third quarter

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Activity	Timetable
C. Sidestream Cigarette Smoke	
1. Smoke chamber design study	Initiate second - third quarter
a. Chamber to smoke at least four cigarettes	
2. Collection for *in vitro* testing	Initiate first quarter and continuing
a. Impaction trap	
b. Elmenhorst cold trap	
c. Solvent filled impaction trap	
d. Cambridge pad	
3. Collection for chemical testing	Third - fourth quarter
a. Impaction trap	
b. Elmenhorst cold trap	
4. Large scale collection for sidestream condensate	Second - third quarter
a. Collection from 30-port Borgwaldt smoking machine--design study	
5. Nitrosamines	First - second quarter
D. Pyrolysis Studies	
1. Water in filler effect on pyrolysis, activity	First quarter
a. 2R1, bright, burley, or 50/50 blend	
b. 300-900°C temperature range	
c. Nitrogen atmosphere	
2. Varied oxygen in nitrogen atmosphere	First quarter
a. One or more levels of oxygen	
b. 2R1, bright, burley, or 50/50 blend	
c. 300-900°C temperature range	

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Activity	Timetable
3. RL base web + K^+ salts	First quarter
a. RL base web control	
b. RL base web + KCl	
c. RL base web + KOAc	
(1) atmosphere to be determined	
(2) 300-900°C temperature range	
4. Pyrolysis base fractionation studies	Second quarter
a. Bright	
b. Burley	
c. Blend	
d. RL + K^+ salts	
5. Research proposal for pyrolysis of pre-treated fillers and alternate pyrolysis procedures	Third quarter
6. Alternate filler types including LTF	Third quarter
7. Pyrolyzate chemistry	Fourth quarter
a. Volatiles	
(1) gc, gc/ms	
b. Other fractions	
(1) Acids, bases, neutrals	
(a) gc, gc/ms	
(b) HPLC	
(c) other	
E. LTF Preparation Studies	Ongoing

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